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ABSTRACT

In free recall learning, taxonomic organization has been studied almost to the exclusion of alternative types of organization. Consequently, little is known about how learning and memory are affected by alternative types of organizations. The present experiments explored the differential effects of two kinds of organization on free recall learning. One type was the familiar taxonomic organization, based on relations of similarity; the other a schematic organization, based on temporal or causal connections between the units. Subjects recalled more items when the material was organized in a schematic organization than when the materials were organized in either a taxonomic or random organization. The findings are discussed in terms of how different types of organization differently affect learning and recall. (Author/GK)

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Schematic and Taxonomic Organization in Free Recall

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Schematic and Taxonomic Organization in Free Recall

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Abstract

In free recall learning, taxonomic organization has been studied almost to the exclusion of alternative types of organization. Consequently, little is known about how learning and memory are affected by alternative types of organizations. The present experiments explored the differential effects of two kinds of organization on free recall learning. One type was the familiar taxonomic organization, the other a schematic organization. Subjects recalled more items when the material was organized in a schematic organization than when the materials were organized in either a taxonomic or random organization. The findings are discussed in terms of how different types of organization differently affect learning and recall.

Many theories of learning have suggested that learning occurs most efficiently when the structure of the material to be learned matches the underlying conceptual system of the learner (Gagne, 1977; Piaget & Inhelder, 1973; Vygotsky, 1978). One way to infer the underlying structure of the conceptual system is to observe how differently organized materials affect processing during learning and remembering. Much of the work showing that organization of the to-be-remembered material is important to the learner has been conducted using free recall tasks.

In free recall tasks, subjects are typically given a list of words to study and are later asked to recall the words in any order. Within this paradigm, some work has been conducted using lists of unrelated words, in which subjects impose their own organization on the items, but much if it has been carried out using taxonomically or categorically related items. The extent to which subjects use the categorical structure is measured by clustering of related items in recall. Taxonomically related lists of words are recalled better than lists which are comprised of randomly chosen words (e.g. Puff, 1970). Further, taxonomically related items within a list are better recalled if the items are blocked in the presentation list within their taxonomic groupings than if the categories are randomly assorted throughout the list (Cofer, Bruce, & Reicher, 1966).

Because of the emphasis on taxonomic organization in these studies we know relatively little about alternate kinds of organization. Furthermore, the emphasis on the study of taxonomic categories to the exclusion of other forms has subtly suggested that taxonomic struc-

tures represent an optimal form of organization. This suggestion is particularly strong in the developmental literature, in which developmental changes in free recall have often been related to changes in organizational preferences. Several investigators have suggested that young children prefer to use "thematic" organizations, whereas adolescents and young adults are more responsive to taxonomic organizations (Ceci & Howe, 1978; Denney & Ziobrowski, 1972; Worden, 1976). Taxonomic classification systems are thus seen as some kind of developmental endpoint.

An emphasis on taxonomic organization is also found in many theories of semantic memory (for a review of these models see Smith, 1978). Recently however, several theories of conceptual structure, (which includes knowledge about events as well as about objects) have emphasized other organizations, such as schemata (Rumelhart, 1981) or scripts (Schank & Abelson, 1977), as the basis of the memory system. Erlich (1979) has suggested that rather than conceiving of the semantic system as organized in a specific way because it produces better performance on a given task, the semantic system should be thought of as consisting of many different types of organization. Bower and Clark-Meyers have shown that an alternate form of organization, rather than taxonomic organization, is useful in free recall learning. Subjects presented with a list of nouns which formed "thematically coherent" topics recalled many more items than subjects who were presented with the same items in a random order.

If we assume that the semantic memory system has multiple bases of organization, it is important to study how these organizations are

used in learning and recall. The present experiments explored the differential effects of two kinds of organization on free recall learning. One type was the familiar taxonomic organization, the other the schematic organization of events (related to the concept of "thematic" organization but theoretically better specified and more detailed; see Rumelhart, 1981). [A distinction has been made between event schemata and scene schemata. See Mandler (1979) for a detailed discussion].

Mandler (1979) suggested several ways in which taxonomic and schematic organizations differ that might be expected to have major effects on encoding and retrieval. Event schemata are temporally or casually organized data structures in which the constituents are connected on the basis of contiguities that have been experienced in time. Schemata are formed on the basis of past experience and consist of a set of variables, or slots, which can be filled, or instantiated in any given instance by values that have greater or lesser degrees of probability of occurence attached to them. This definition encompasses two ways in which schematic organization differs from taxonomic organization. First, both kinds of organization have a hierarchical structure, but schematic organizations have temporal or causal connections between the units, whereas categorical organizations are based on relations of similarity. This difference can be described in terms of horizontal vs. vertical connections among the units. In a familiar event sequence, for example, the constituents are part of higher-order units, and thus have vertical connections. For example, in a restaurant script, looking at a menu might be a subpart of an ordering unit, so the connection between looking at a menu and

ordering is a vertical one. By virtue of their temporal organization, however, they are also connected horizontally, each one leading to the next in a sequence. In a categorized list of words, on the other hand, the units are related in a principled way only vertically to their superordinate. The relationship between two members of a given catergories, such as cow and dog, are not specified, and the ordering of these items within a given list is not important and is often variable.

The second difference between the two forms of organization is the likelihood of their activation in a given situation. Mandler (1979) suggested that familiar event sequences automatically activate sets of expectations, or schemata, which then play a major role in structuring the incoming information. An organization based on similarity relations, on the other hand, is optional, in that it is not invariably aroused by the material at hand. Any set of items has many relations based on similarity: category membership, similarity of functions, and various physical features such as color, size, shape, any or all of which may be noticed (sometimes haphazardly) at the time of encoding. For example, an elephant may be categorized as an animal, a large thing, a gray thing, and so on. The type of similarity relations which are aroused at a given time are optional.

The differences in the two types of organization should result in characteristic differences in retrieval of the material at a later date. First, the schematic organization is more likely to be activated by the cues provided by the retrieval situation itself. Second, the schematic organization provides a well-specified retrieval

plan; in the case of materials such as stories or scripts, a starting point is given, a directed set of connections between each item and the next, and a stopping point as well. These two characteristics probably combine with the size of the set of possible items to be searched. Although the size of schematic domains is largely unknown and no norms of likelihood of occurrence have been established (comparable to word frequency), it seems plausible that the domain of likely events relevant to a given schema may be smaller than that found in categorical organizations, at least as these are typically formulated in list learning studies. The pool of items used by the list constructor is usually limited only by word frequency, and from the point of view of the learner the set may be very large.

Several predictions can be made about differences in recall as a function of these two ways of organizing materials. First, the schematic organization provides a retrieval plan that is more likely to be successful, thus resulting in more complete recall. When subjects begin to retrieve schematically related items they should be able to empty each set more completely than when retrieving items from a taxonomic category. In the latter case, the models provided to account for recall have assumed random entry, sampling with replacement, and a stop rule based on the proportion of items recovered to those remaining (e.g., Rundus, 1973). Also, the difference in the retrieval plans in the two cases also suggests that when a schematic group is entered during the retrieval process all available items will be output together, whereas in the categorical case subjects may be more likely to go back to a category that has not been emptied in an attempt to retrieve more items from it.

It has been difficult to test these predicted differences, however, since the nature of the materials used to exemplify the two types of organization has varied widely. Typically schematic organization has been studied by using stories or other event sequences, whereas taxonomic organization has been studied using lists of nouns. The present experiments used lists of items, chosen so that they exemplified both kinds of organizations. In the first study, phrases, rather than words, were used to ensure that schematic organizations would be aroused. Each phrase contained a noun which also exemplified a common taxonomic category. Even under these circumstances it is difficult, if not in principle impossible, to equate the "strength" or saliency of the two organizations. Indeed if the above charaterization of the schematic organization is correct, schematic organizations may typically be more salient. Nevertheless, it seems reasonable to provide plausible examples of both organizations , show that subjects are responsive to both, and then investigate how they use them in a free recall situation.

In Experiment 1, five schematic sequences as well as five taxonomic groupings were constructed yielding a stimulus list of 25 items. The five schematic sequences used were: going skiing, going to a ballet, going to a party, going to a baseball game, and going to Hawaii. The five taxonomic categories used were: places, events, food, clothing, and items one would buy in the context of the schema. (See Figure 1 for the schematic and taxonomic orderings and membership). The items were presented in three different orderings: 1) blocked according to taxonomic categories, 2) blocked according to schematic categories, and 3) in a random order. Additionally, presentation time

was varied as an exploratory manipulation, because little or no work has been done on the free recall of short phrases.

METHOD

Design. The design for this experiment consisted of two between-subject factors: Organization (blocked according to taxonomic categories, blocked according to schematic categories, or random presentation), and Presentation Time (five or ten seconds).

Subjects. Subjects were 72 undergraduate students taking lower-division Psychology classes at the University of California, San Diego, who received course credit for their participation. There were 12 subjects in each condition.

Materials and Procedure. Each subject was presented with a list of 25 short phrases. The set of phrases was designed to be classifiable into two different organizational structures, schematic or taxonomic, depending on how they were grouped (see Figure 1). The phrases were chosen so that they formed well organized event structures and each phrase contained a noun which also exemplified a common taxonomic category. In each presentation condition the order of presentation was determined by a Latin square. Four randomized lists were generated for each organization condition. In the taxonomic and schematic conditions the presentation of the five blockes were randomized. In the random condition the phrases were randomized with the restriction that no two phrases from either a taxonomic or schematic group were presented adjacently. All subjects were tested in

individual sessions lasting approximately fifteen minutes. They were instructed that they would hear a list of short phrases and that after they had heard all the phrases they would have to recall as many as they could. The phrases were recorded on cassette tape and were played at one of two presentation rates: either 5 or 10 seconds. After subjects heard all the phrases they were instructed that they should recall the phrases in any order and that they should try to recall the phrases exactly as they were worded on the tape. If they could not remember the exact wording, however, they were to say what they thought was stated. Subjects were asked to recall orally and their recall was tape recorded. The recall session lasted for approximately 3 minutes. The subjects were not instructed about the organizational structure of the list.

RESULTS

Table 1 presents the results of the recall and clustering analyses. Each recall protocol was analyzed for clustering of both schematic and taxonomic organization in recall. There were no significant interactions involving organization or presentation rate for any of the dependent variables, so only the main effects will be discussed.

Recall. The number of items recalled minus repetitions and intrusions was submitted to an analysis of variance comparing organization and presentation rate. Verbatim replications as well as paraphrases of the original phrases were accepted as correct responses.

Subjects in the 10 sec condition recalled more items (m = 16.61) than those in the 5 sec condition (m = 14.30), $F(1,66) = 6.80$, $p < .05$. There were also significant differences in the amount recalled depending on the organization of the presentation list, $F(2,66) = 20.65$, $p < .05$. Sheffè tests indicated that the schematic organization led to better recall (m = 19.3), than either the taxonomic organization (m = 14.6) or the random condition (m = 12.5) ($p < .05$); the latter two conditions did not significantly differ.

Clustering. Clustering in recall was measured with the Relative Ratio of Repetition (RRR), which varies from 0 in the case of no clustering to 1.00 in the case of perfect clustering (Bousfield & Bousfield, 1966).

Taxonomic clustering. An analysis of variance of taxonomic clustering scores indicated that there was no significant effect of rate of presentation, $F(1,66) = 3.14$, $p > .05$. There was a significant overall effect of organization, $F(2,66) = 63.33$, $p < .05$, with subjects in the taxonomic group clustering taxonomically to the greatest extent (m = .65), subjects in the random group clustering in taxonomic categories at a low level (m = .19), and subjects in the schematic group hardly clustering at all by taxonomic categories (m = .01). Scheffè tests indicated that there was significantly more taxonomic clustering in the taxonomic condition than in either the schematic or random conditions, $P > .05$. In addition, there was significantly more clustering in the random condition than in the schematic condition, $p < .05$.

Schematic clustering. An analysis of variance was also conducted

for schematic clustering scores. Once again there was no significant effect of presentation rate, $F(1,66) = 1.52$, $p > .05$, There was, however, a significant overall effect of list organization, $F(2,66) = 88.97$, $p < .05$. indicating that there was a significant difference in clustering between the schematic group, ($m = .97$), the taxonomic group ($m = .27$), and the random group ($m = .26$). Scheffè tests indicated that there was significantly more schematic clustering in the schematic condition than in either the taxonomic or random conditions, $p < .05$. There was no significant difference in schematic clustering between the taxonomic and random conditions, $P > .05$.

There was a significant difference between the subjects who were presented the taxonomically blocked list and the subjects who were presented the schematically blocked list in the number of times the subjects entered each category within a list, $F(1,44) = 26.77$, $p < .05$. Subjects given the taxonomic list entered a category on the average 1.7 times. Subjects given the schematic list however entered each category only an average of 1.1 times. In addition the two groups differed in the amount of items recalled from a given category the first time that category was entered, $F(1,44) = 64.03$, $p < .05$. Subjects in the taxonomic group recalled on the average 2.2 items the first time a category was recalled whereas subjects in the schematic condition recalled on the average 3.9 items the first time a category was recalled.

DISCUSSION

The purpose of Experiment 1 was to examine the effects different organizational structures have on memory performance. Two hypotheses were tested. First, it was predicted that a schematic organization would guide both the encoding and retrieval processes more efficiently and comletely than a taxonomic organization, and thus lead to greater recall in the former case. Second, it was predicted that when given a schematically blocked list, subjects would enter a schematic group only once and would recall other items from that group adjacently. Subjects given a taxonomically blocked list would tend to enter a given category more than once and recall fewer items from that category at one time. Both hypotheses were confirmed.

Consistent with the second hypothesis, clustering analyses showed that the schematically blocked condition produced essentially perfect clustering (.97), whereas the taxonomically blocked condition resulted in lower clustering scores (.66). These data could be interpreted in another way however. The exemplars used in this experiment might not be "good" members of the given taxonomic categories, or the categories might not be particularly obvious ones. Alternatively, the instances comprising the schematic organization seemed to be very "good" exemplars of their categories. This would make the schematic organization more salient and would make detection of this organization easier. Given this explanation, it would not be surprising that the schematic organizational structure led to greater recall. Although the lack of equality in goodness of membership in different organizational structures may be an inherent aspect of this kind of work, a second

experiment was conducted in which care was taken to insure that each item within the taxonomic organization was a good exemplar of its associated superordinate category.

EXPERIMENT 2

This experiment was designed to replicate the findings of Experiment 1 with a new set of stimulus materials. In order to safeguard against having the stimulus items fit better into the schematic organization than the taxonomic organization familiar categories of items and common exemplars were used. Once again, the stimulus list was constructed so that the phrases could be organized into two distinct organizational structures, taxonomic and schematic. The list was comprised of 25 short phrases yielding five taxonomic and five schematic categories. The five schematic sequences used were: living on a farm, going to a lake, playing in a park, hiking in the woods, and working on a ranch. The five taxonomic categories used were: places, articles of clothing, animals, vehicles, and food. (See Figure 2 for the schematic and taxonomic category orderings and membership).

As in Experiment 1, the items were presented in three different orderings; 1) blocked according to schematic categories, 2) blocked according to taxonomic categories, and 3) random order. In addition, a manipulation of the presentation list was added. This consisted of presenting the items as short phrases as before, or presenting only the taxonomically classifiable noun in each phrase. This condition

was included to see if the previous results were due to the use of phrases rather than the more traditional list of nouns. One might expect the schematic organization to be less obvious and the taxonomic organization more obvious in the case where only nouns were used.

METHOD

Design. The design for this experiment consisted of two between subject factors: Organization (taxonomic, schematic, or random), and Items (phrases or nouns).

Subjects. Subjects were an independent sample of 72 undergraduate students taking lower-division Psychology classes at the University of California, at San Diego, who received course credit for their participation. There were 12 subjects in each condition.

Materials and Procedure. The materials were designed using the same constraints as used in Experiment 1, except that special care was taken to make sure that the items were good exemplars of the taxonomic categories. The stimulus list contained either short phrases or nouns. Two randomized orderings were prepared for each list. In the blocked conditions the categories were randomly ordered using a Latin Square, but the items within a category were presented in a constant order. The randomization constraints were the same as those used in Experiment 1.

Subjects were tested in groups, of 1 to 6, in sessions lasting approximately fifteen minutes. Subjects were instructed that they would hear a list of short phrases or nouns and that after they heard

all the items they would be asked to recall them in any order. The subjects then heard all 25 items. The items were recorded on cassette tape and were played at a rate of five seconds per item. After the subjects heard all the items, they were instructed that they were to recall the items exactly as they were heard on tape, but if they were unsure of the exact wording, they should say what they thought was stated. Subjects were asked to write down the items in a booklet, one item per page, with the constraint that they were not allowed to look back at any of the items they wrote down previously. The recall session lasted approximately four minutes. None of the subjects were instructed about the organizational structure of the list.

RESULTS

Table 2 presents the results of the recall and clustering analysis. Each recall protocol was analyzed for clustering for both schematic and taxonomic organization in recall. There were no significant interactions found between Organization and Items for any of the independent variables, so only the main effects will be discussed below.

Recall. The number of items recalled minus repetitions and intrusions was submitted to an analysis of variance comparing organization and items. Once again, verbatim replication as well as paraphrases of the phrases were accepted as correct responses; synonyms of the nouns were also accepted as correct responses. Subjects presented with nouns recalled more items ($m = 15.67$) than subjects presented

with phrases (m = 13.25), $F(1,66) = 8.79$, $p < .05$. There was also a significant main effect of list organization, $F(2,66) = 9.73$, $p < .05$, with subjects in the schematic group recalling the most (m = 16.92), subjects in the taxonomic condition recalling the next greatest amount (m = 13.79), and subjects in the random condition recalling the least (m = 12.67). Scheffè tests indicated that subjects in the schematic condition recalled more items than subjects in the random condition ($p < .05$). However, the idifference between the taxonomic and the random condition was not significant. ($p > .05$). These results replicate those of Experiment 1.

Clustering. Clustering was again measured using the Relative Ratio of Repetition (RRR).

Taxonomic Clustering. An analysis of variance was conducted on taxonomic clustering scores. The difference in taxonomic clustering between the noun condition (m = .40) and the short phrase condition (m = .32) was not significant, $F(1,66) = 3.60$, $p > .05$. There was an overall effect of organization with subjects in the taxonomic group clustering the most (m = .64), subjects in the random group clustering at the next highest level (m = .29) and subjects in the schematic condition clustering the least (m = .15). $F(2,66) = 38.25$, $p < .05$. Scheffè tests indicated that there was more taxonomic clustering in the taxonomic condition than in either the random or schematic presentation conditions ($p < .05$) and significantly more taxonomic clustering in the random condition than in the schematic condition ($p < .05$).

Schematic clustering. Schematic clustering scores were also subjected to an analysis of variance. As found with taxonomic

clustering, there was no significant main effect of item type, $F(1,66) = .00$. Subjects in the short phrase condition had a mean clustering score of .34 and subjects in the noun condition had a mean schematic clustering score of .35. There was however, a significant overall effect of organization $F(2,66) = 55.02$, $p < .05$, on schematic clustering between the schematic group ($m = .67$), the taxonomic group ($m = .18$) and the random group ($m = .19$). There was significantly more schematic clustering in the schematic group than in either the taxonomic or random groups ($p < .05$). The difference between the taxonomic and random groups was not significant, $F(1,66) = .08$, $p > .05$.

It was of interest to determine if this study also replicated the effect that once subjects entered a schematic organization they would recall more items from that unit at one time than from a taxonomic unit. This prediction was once again confirmed. Subjects in the schematic condition, the first time they entered a schematic category, recalled on the average 2.52 items from that category. Subjects in the taxonomic condition only recalled on the average 2.07 from that category. The difference between these two means was significant, $F(1,46) = 4.58$, $p < .05$. This effect did not vary as a function of which list was presented. However, there was no significant difference between the subjects who were presented the schematically blocked list and the subjects presented the taxonomically blocked list in the number of times the subjects entered a category within a list, $F(1,44) = .05$, $p > .05$. Subjects given the taxonomically blocked list enter a category on the average 1.73 times and subjects given the schematically blocked list entered a category on the average 1.76 times.

DISCUSSION

The recall data from Experiment 2 replicated those found in Experiment 1, with subjects in the schematic condition recalling more items than subjects in either the taxonomic or random conditions. Although nouns were significantly better recalled than short phrases this variable did not affect any other measure. In addition to the higher recall in the schematic conditions, there were characteristic differences in recall performance. When subjects entered a schematic category for the first time, they recalled more items from that category than subjects entering a taxonomic category. However, the two groups of subjects did not differ in the number of times they entered a given category.

Schematic clustering in the schematic condition was lower than in the previous experiment (.67) and taxonomic clustering in the taxonomic condition remained at about the same level (.64). Thus, as measured by clustering scores, the two organizations were used approximately equally often in the two blocked conditions. Nevertheless, subjects recalled more from the schematically blocked list than from the taxonomically blocked list, a finding that was equally true for nouns as for phrases. It is still possible however, that the exemplars used in this experiment might not be as good members of the taxonomic categories as they are of the schematic categories. As a check upon the relative "goodness-of-fit" of the exemplars into the two organizations, a third experiment was conducted in which independent groups of subjects were asked to sort the stimulus materials from

Experiment 1 and Experiment 2 into schematic and taxonomic groupings.

Experiment 3

In this experiment subjects were either given the stimulus materials from Experiment 1 or Experiment 2 and were asked to sort the items into groups in one of three ways: into schematic groups, taxonomic groups, or with free sort instructions, i.e., they were only told to put the items into piles so that all the items in a pile went together in some way. For purposes of exposition this experiment will be discussed as two studies. Study 1 will be concerned with the results found using the materials from Experiment 1 and Study 2 will be concerned with the results found using the materials from Experiment 2.

Study 1

Design. The design of this experiment consisted of one between-subject factor: Sorting Instructions. Subjects were either given free sort instuctions, instructions to sort into taxonomic groups, or instructions to sort into schematic groups.

Subjects. Subjects were an independent sample of 27 undergraduate students taking lower-division Psychology classes at the University of California, San Diego, who received course credit for their participation. There were 9 subjects in each condition.

Materials and Procedure. Subjects were presented the 25 phrases

which were used as the stimulus materials in Experiment 1. Each phrase was typed in the center of a 5x7 index card. Three randomized orders were generated with the constraint that no two phrases from either a taxonomic or schematic group were presented adjacently. All subjects were tested in individual sessions lasting approximately twenty minutes. Subjects were instructed that they would be presented a packet of cards and on each card there would be written a short phrase. Their job would be to sort the cards into piles so that all the phrases in a pile went together in some way. Subjects in the taxonomic sorting group were told that the phrases were made up so that if you put them together into piles, each pile would consist of items from a specific category. Items belonging to a specific category were then defined as items which were similar to each other in that they all shared a set of common properties. Subjects in the schematic sorting group were told that the phrases were constructed so that if you put them together into piles, each pile would represent a specific event sequence. They were further instructed that items went together because they occur together in time or space, that is, they might find these things at certain places or these things might occur together contiguously in time. An example of either a common category or event sequence was then given. Each subject was then presented with the pile of cards and was asked to read each card and to then lay the cards out on the table so that all the cards could be seen. They were then told that they were to put all the cards into five piles and that each pile could only have five cards. After the cards were sorted into piles each subject was given five blank cards and asked to write a short title for each pile.

Results. The first dependent measure of interest is whether subjects, when asked to sort the items into either taxonomic or schematic groupings, matched the organization provided to the subjects in Experiment 1. Of the subjects told to sort the items into taxonomic groupings, all of them sorted the materials in aggreement with the taxonomic organization provided. Of the subjects directed to sort the items into schematic groupings, seven out of nine sorted the materials in agreement with the schematic organization provided in Experiment 1. For the two subjects who did not fully agree with the presumed organization, an average of 3 items were sorted out of place.

The second dependent measure is whether subjects, when given free sort instructions, tended to sort the materials into taxonomic groupings, schematic groupings, or a combination of both. One out of the nine subjects sorted the materials in aggreement with our taxonomic groups. The other eight subjects sorted the items into schematic groupings. Of these subjects only one did not fully agree with the organization provided in Experiment 1. However for that subject only two items were missorted.

Discussion

The results from this study further confirm the possibility that the schematic organization used in Experiment 1 might be more salient than the taxonomic organization and detection of the schematic organization might have been easier for the subjects. Of the nine subjects given the free sort task, only one of the subjects choose to sort the items into taxonomic groupings. All the subjects who were instructed

to sort the items into taxonomic groupings agreed with the taxonomic organization imposed by the experimenters. There was some minor disagreement between the experimenter's presumed schematic organization and the subject's schematic groupings but the disagreement only concerned a few of the items.

Study 2

Design. The design of this study consisted of two between-subject factors: Sorting Instruction (taxonomic sort, schematic sort, or free sort) and Items (phrases or nouns).

Subjects. Subjects were an independent sample of 60 undergraduate students taking lower-division Psychology classes at the University of California, San Diego, who received course credit for their participation. There were 10 subjects in each condition.

Materials and Procedure. Subjects were presented either the 25 phrases or the 25 nouns which were used as the stimulus materials in Experiment 2. Each phrase or noun was typed in the center of a 5x7 index card. Two randomized orders were generated with the constraint that no two phrases from either a taxonomic or schematic group were presented adjacently. All subjects were tested in individual sessions lasting approximately twenty minutes. The instructions and procedure were the same as in Study 1.

Results. Once again, the first dependent measure of interest is

whether subjects when asked to sort the items into either taxonomic or schematic groupings, matched the organization provided to the subjects in Experiment 2. Of the subjects who were given nouns and told to sort the items into taxonomic groupings, all of them sorted the materials in aggreement with the taxonomic organization provided. Of the subjects who were given phrases and told to sort the items into taxonomic groupings, 7 out of the ten subjects sorted the materials in aggreement with the organization provided in Experiment 2. For the three subjects whose sorts did not fully aggree with the presumed organization, an average of 5.33 items were missorted. Of the subjects who were given nouns and were told to sort the items into schematic groupings, only one of the ten subjects agreed with the schematic organization presented in Experiment 2. For those that did not agree, an average of 6.44 items were missorted. Of the subjects who were given phrases and were asked to sort the items into schematic groupings, none of them agreed with the presumed organization, with an average of 5.7 items being missorted.

The second dependent measure is whether subjects, when given free sort instructions, tended to sort the materials into taxonomic groupings, schematic groupings, or to use a combination of both types of organizations in their sorts. Of the ten subjects presented the nouns, 8 sorted the items in agreement with the taxonomic organization and two sorted some of the items into taxonomic groupings and some into schematic groupings. Of the ten subjects presented the phrases, 5 of the subjects sorted the items into schematic groupings, 4 of the subjects sorted into taxonomic groupings, and one subject used both types of organizations to sort the items. Of the five subjects who

sorted the items into schematic groupings, none of them agreed with the presumed schematic organization, misclassifying on the average, 8 items. Of the four subjects who sorted the items into taxonomic groupings, all of them agreed with the presumed taxonomic organization.

Discussion

The results from this study indicate that the manner in which subjects sorted the materials of Experiment 2 into groupings was dependent on the type of materials presented. When subjects were presented with a list of nouns, they tended to sort the materials into taxonomic clusters. When subjects were presented with phrases, they tended to sort the materials into schematic groups. In addition, the results indicate, that for these stimulus materials, the taxonomic organization was a more salient or obvious one. Subjects who were told to sort the items into taxonomic groupings tended to make very few misclassifications in terms of the presumed taxonomic organization. However, only one subject out of twenty sorted the material in aggreement with the presumed schematic organization and the other subjects widely disagreed with the presumed sort and each other.

General Discussion

These experiments were designed to investigate whether characteristic differences in processing were related to differences in organization. It was assumed that expectations could be used to guide

both the encoding and retrieval processes to a greater extent with a schematic organization than with a taxonomic organization. The use of these expectations would thus enable different processing characteristics to be associated with different types of organization. The results of these experiments seem to support such an hypothesis. In both experiments, more items were recalled in the schematically blocked condition than in the taxonomically blocked or random conditions. In the second experiment, the clustering data suggested that both organizations were equally available to and used by subjects to organize their recall. At the same time, the sorting data suggested that the schematic organization was a less salient or obvious one. Nevertheless, more was recalled when the schematic organization was used and within category effects in recall differed as well.

In addition, the results provide some evidence that expectations provided by the schematic organization are being applied during the retrieval stage as opposed to the encoding stage. While subjects did not agree with the way that we grouped the stimulus materials in terms of schematic organization in Experiment 2, they were able to use the provided organization to facilitate recall. This would argue that subjects were not able to use their expectations with the schematic organization during the encoding process, but once having recognized that organization were able to use it effectively to guide retrieval. In conclusion, these results suggest characteristic differences in the use of schematic and taxonomic organizations in free recall learning that need further exploration if models of learning and recall are to be advanced.

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FIGURE 1

ARRANGEMENT OF STIMULUS MATERIALS

FROM EXPERIMENT 1 INTO TWO ORGANIZATIONAL STRUCTURES

TAXONOMIC ORGANIZATION	SCHEMATIC ORGANIZATION
FOOD	GOING SKIING
EAT PINEAPPLE	GO TO MOUNTAINS
EAT PEANUTS	PUT ON DOWN JACKET
EAT BIRTHDAY CAKE	BUY LIFT TICKET
DRINK HOT CHOCOLATE	SKI DOWN SLOPES
DRINK CHAMPAGNE	DRINK HOT CHOCOLATE
CLOTHING	GOING TO A BALLET
PUT ON EVENING CLOTHES	BUY OPERA GLASSES
PUT ON PADRE'S CAP	PUT ON EVENING CLOTHES
PUT ON PAPER HAT	GO TO THEATER
PUT ON BATHING SUIT	WATCH BALLET
PUT ON DOWN JACKET	DRINK CHAMPAGNE
PLACES	GOING TO A PARTY
GO TO MOUNTAINS	BUY PRESENT
GO TO HAWAII	GO TO PARTY
GO TO THEATER	PUT ON PAPER HAT
GO TO PARTY	EAT BIRTHDAY CAKE
GO TO STADIUM	PLAY CHARADES
ACTIVITIES	GOING TO A BASEBALL GAME
PLAY CHARADES	PUT ON PADRE'S CAP
WATCH BALLET	GO TO STADIUM
SKI DOWN SLOPES	BUY ADMISSION TICKET
WATCH BASEBALL GAME	WATCH BASEBALL GAME
SWIM IN OCEAN	EAT PEANUTS
THINGS ONE WOULD BUY	GOING TO HAWAII
BUY ADMISSION TICKET	BUY PLANE TICKET
BUY LIFT TICKET	GO TO HAWAII
BUY PLANE TICKET	EAT PINEAPPLE
BUY OPERA GLASSES	PUT ON BATHING SUIT
BUY PRESENT	SWIM IN OCEAN

Table 1

Recall and Clustering Performance in Experiment 1

as a function of List Organization and Presentation Rate

PRESENTATION RATE	LIST ORGANIZATION		
	RANDOM	TAXONOMIC	SCHEMATIC
RECALL			
5 second	10.83	12.83	19.25
10 second	14.17	16.33	19.33
TAXONOMIC CLUSTERING*			
5 second	.11	.60	.01
10 second	.26	.71	.01
SCHEMATIC CLUSTERING*			
5 second	.32	.31	.97
10 second	.21	.23	.96

* Clustering was measure with the Relative Ratio of Repetition (RRR), (Bousfield & Bousfield, 1966).

FIGURE 2

ARRANGEMENT OF STIMULUS MATERIALS

FROM EXPERIMENT 2 INTO TWO ORGANIZATIONAL STRUCTURES

TAXONOMIC ORGANIZATION	SCHEMATIC ORGANIZATION
PLACES	LIVING ON FARM
LIVE ON FARM	LIVE ON FARM
SWIM IN LAKE	WEAR OVERALLS
PLAY IN PARK	MILK COW
HIKE IN WOODS	GROW CORN
WORK ON RANCH	DRIVE TRACTOR
CLOTHING	GOING TO THE LAKE
WEAR OVERALLS	PUT ON BATHING SUIT
PUT ON BATHING SUIT	SWIM IN LAKE
TEAR JEANS	SAIL BOAT
PULL ON BOOTS	CATCH FISH
GET COWBOY HAT	EAT SANDWICH
ANIMALS	GOING TO THE PARK
MILK COW	PLAY IN PARK
CATCH FISH	LICK ICECREAM
RUN WITH DOG	PEDAL BICYCLE
CHASE BEAR	RUN WITH DOG
HITCH UP HORSE	TEAR JEANS
VEHICLES	GOING TO THE WOODS
DRIVE TRACTOR	PUT ON BOOTS
SAIL BOAT	HIKE IN WOODS
PEDAL BICYCLE	PICK BERRIES
RIDE IN JEEP	RIDE IN JEEP
SIT IN WAGON	CHASE BEAR
FOOD	LIVING ON RANCH
GROW CORN	WORK ON RANCH
EAT SANDWICH	GET COWBOY HAT
LICK ICECREAM	BARBECUE MEAT
PICK BERRIES	HITCH UP HORSE
BARBECUE MEAT	SIT IN WAGON

TABLE 2

RECALL AND CLUSTERING PERFORMACE IN EXPERIMENT 2

AS A FUNCTION OF ITEMS AND LIST ORGANIZATION.

ITEMS	RANDOM	TAXONOMIC	SCHEMATIC
RECALL			
PHRASE	10.96	12.50	16.34
NOUN	14.42	15.09	17.50
TAXONOMIC CLUSTERING*			
PHRASE	.24	.59	.12
NOUN	.34	.69	.18
SCHEMATIC CLUSTERING*			
PHRASE	.23	.15	.65
NOUN	.15	.20	.69

* CLUSTERING WAS MEASURED WITH THE RELATIVE RATIO OF REPETITION (RRR), (BOUSFIELD & BOUSFIELD, 1966).